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Final Evaluation of North Carolina's Program to Regulate Air Pollution from Stationary Sources

Booz-Allen and Hamilton, Inc.
Bethesda, MD

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CEQ and EPA sponsored five studies examining the response of sources to the regulatory approach to controlling air pollution, with emphasis on the post-compliance emissions history. The study areas are: North Carolina (3 vols), Houston (3 vols), San Diego (3 vols), Chicago (3 vols), and New Jersey (2 vols).

In order to evaluate North Carolina's effectiveness in promoting both initial and continuing compliance, this report integrates the findings from the Task I review and the Task II examination of emissions performance at 20 stationary sources. Based on the findings, it recommends changes to the programs which will strengthen their effectiveness, particularly in the promotion of continuing compliance.

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FINAL REPORT: TASK III

Final Evaluation of North Carolina's Program to Regulate Air Pollution From Stationary Sources

JULY 1, 1979

PREPARED FOR

PRESIDENT'S COUNCIL ON ENVIRONMENTAL QUALITY

OFFICE OF PLANNING AND EVALUATION
U.S. ENVIRONMENTAL PROTECTION AGENCY

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June 26, 1979

Mr. James S. Vickery
Office of Planning and Evaluation
Room 1019-B (West Tower)
U.S. Environmental Protection Agency
401 M Street, S.W.
Washington, D.C. 20460

Dear Jim:

We are pleased to submit our final Task III report entitled "Final Evaluation of North Carolina's Program to Regulate Air Pollution From Stationary Sources." Key contributors to the report were Joanne Wyman of Booz, Allen, and John Richards and Tom Mappes of PEDCo Environmental.

This report summarizes our findings on source performance developed during the case studies conducted in Task II. It also integrates these findings with our preliminary findings on agency performance from Task I and presents an assessment of North Carolina's major strengths and weaknesses in promoting initial and continuing compliance among stationary sources. Where we have identified weaknesses, we have recommended specific program adjustments. Finally, we have presented a discussion of several economic incentive measures which could be used to supplement or replace the current direct regulation approach.

While we feel that this report contributes some interesting and useful insights on the success of the direct regulation approach, two constraints prevented us from making our findings and recommendations as definitive and comprehensive as we had hoped. First, as we have discussed with you throughout the project, neither the agency program data nor source emissions data was sufficient or of consistently high quality to provide a complete picture of either agency activities or source responses. Second, we had fewer resources than anticipated with which to conduct the Task III integration of findings. At your request, we had reallocated some of the resources earmarked for Task III to the collection of additional agency performance data for Task I. Consequently, we were unable to conduct as thorough a review of economic incentive alternatives as initially anticipated.

We hope you find this report useful, and we will be available to answer any questions on it which you may have.

Sincerely,

BOOZ · ALLEN & HAMILTON Inc.

Alan L. Farkas
Principal

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I. EXECUTIVE SUMMARY

The purpose of this report is twofold. First, in order to evaluate North Carolina's effectiveness in promoting both initial and continuing compliance, it integrates the findings from our Task I review of the Division of Environmental Management's (DEM) air quality programs and the Task II examination of the emissions performance of 20 stationary sources. Second, based on the integrated findings, it recommends changes to the programs which will strengthen their effectiveness, particularly in the promotion of continuing compliance. Changes discussed include both program adjustments within the existing regulatory framework as well as economic incentive alternatives to direct regulation. Since the data gathering on DEM programs occurred primarily in the summer of 1978, prior to the September 1978 reorganization, both the findings and recommendations may not reflect current operations.

The findings and recommendations are presented in the following three chapters:

- Source Performance
- Effectiveness of Agency Programs
- Economic Incentives.

The first of these chapters briefly discusses the excess emissions problem in North Carolina. The second chapter presents the principal findings on agency strengths and weaknesses and identifies some needed adjustments to current programs within the existing direct regulation approach to stationary source control. The final chapter describes some alternative approaches and their potential applicability to the particular situation in North Carolina. Source and agency costs of control are presented in Appendices A and B of the report.

1. SOURCE PERFORMANCE

This chapter briefly summarizes the findings from our examination in Task II of the compliance status of 20 sources in nine industrial categories. These findings are as follows:

certain. The principal strength of the program was that it included existing as well as modified and new sources. Specific weaknesses are:

- Inadequate technical reviews of applications
- Insufficient concern with O&M measures
- Lack of coordination between air and water quality permitting.

Recommended program adjustments within the direct regulation framework are:

- Rotation of field inspectors and permit reviewers
- Expansion of regional role in permit review
- Development of permit review guidelines to detect design problems
- Inclusion in the permit of recordkeeping and monitoring requirements on a case-by-case basis
- Incorporation in the permit of minimum preventive maintenance requirements
- Development of guidelines for simultaneous, coordinated air and water permits technical review.

(2) The Surveillance Program

In general, the agency has sufficient surveillance mechanisms available for detecting violations and fostering their correction but fails to maximize their effectiveness. Major strengths include the use of the permit renewal process to detect violations and therefore to encourage continuing compliance and the vigorous use of visible emissions evaluations to identify and correct opacity problems. The most significant weakness is the superficiality of site inspections. Possible program adjustments to correct this problem include:

- Issuance of inspection guidelines
- Encouragement of additional training
- Increase of interaction among regional staffs
- Improvement of inspection equipment.

To counteract these problems, we have recommended that within the inevitable constraints of the civil service regulations, the agency create a professionally rewarding working environment. In addition, it should revise its budget system to track expenditures by program element and should design and implement recordkeeping quality controls.

3. ECONOMIC INCENTIVES

The final chapter of the report discusses the following four categories of incentives:

- Financing incentives
- Pricing incentives
- Hybrid permit systems
- Promotion of nonpolluting goods.

We describe several options within each category and their possible applicability to the excess emissions situation and specific program weaknesses in North Carolina. In many cases, our analysis shows, the specific technical and management problems found in current programs probably would not be resolved or eliminated by an economic incentives approach. We recommend, therefore, additional investigation to document convincingly the appropriateness of economic incentives.

II. SOURCE PERFORMANCE

This chapter briefly summarizes the findings from our examination in Task II of the compliance status of 20 of North Carolina's approximately 1000 major sources. Detailed analyses for each of the 20 sources are in the Task II final report. This summary presents the following four categories of information:

- Emissions estimates for each source
- Estimate of levels, frequency, and duration of excess emissions by industrial category
- Estimates of levels, frequency, and duration of excess emissions by pollution control system category
- Causes of postcompliance excess emissions.

Capital and O&M costs incurred by each source, related to emissions reductions, are presented in Appendix A.

1. SUMMARY OF EMISSIONS ESTIMATES

Based on available data and external and internal inspections of the control equipment, we attempted to identify the level, frequency, and duration of excess emissions episodes for each of the 20 sources examined. The results of the emissions estimates for each source are displayed in Exhibit II-1 on the following page. This exhibit shows the values of potential uncontrolled emissions and allowable emissions (emission rate x total operating hours for the period covered by the study). With these values as a context within which to evaluate actual performance, the table summarizes excess emissions. It also shows "emission credits," that is, the extent to which actual emissions were below the allowable emissions. Finally, the table indicates the accuracy of our estimates. The level of accuracy varies according to the quality of available data. As noted in our Task II report, stack testing data was quite sparse and many sources had no or inadequate operating records with which to develop reliable estimates.

2. PERFORMANCE BY INDUSTRIAL CATEGORY

In Exhibit II-2 we integrate the data on excess emissions according to industrial category. For 9 source categories, the table shows the estimated number of emissions events in each of 4 categories of duration. The exhibit also shows the estimated excess emissions in tons per year and the estimated average annual emissions as a percent of allowable emissions. The steam generating category shows the largest total number of excess emissions events of the longest duration, while the petrochemical, fertilizer and surface coating operations showed the highest incidence of excesses lasting under one day. It is important to remember, however, that since the most number of sources in any of the 9 categories studied was 4, extrapolation of these findings to the entire State of North Carolina would be tenuous. Finally, the exhibit shows the types of data which form the basis for the estimates.

3. PERFORMANCE BY CONTROL EQUIPMENT CATEGORY

Exhibit II-3 displays the level, frequency, and duration of excess emissions for five types of pollution control devices:

- Electrostatic precipitators (5)
- Fabric filters (5)
- Carbon bed absorbers (2)
- Scrubbers (7)
- Afterburners (1).

As in Exhibit III-2, the indicators used to develop estimates of excess emissions are shown. The table shows that the scrubbers category has the greatest frequency of excess episodes lasting longer than 12 months and the greatest frequency of episodes lasting between 1 and 12 months. The fabric filters category had a large number of excess emissions events lasting less than 1 day.

4. CAUSES OF EXCESS EMISSION

Exhibit II-4 displays the following eight causes of excess emissions:

- Poor design efficiency
- Corrosion/improper materials of construction

EXHIBIT II-3
Excess Emissions By Control Equipment Category

CONTROL DEVICE TYPE	COMBINED YEARS OF EMISSIONS STUDIED	ESTIMATED NUMBER AND DURATION OF EXCESS EMISSIONS EVENTS				ESTIMATED EXCESS EMISSIONS[2] (T/yr)	ESTIMATED AVERAGE ANNUAL EMISSIONS[2] (% ALLOWABLE)	EMISSIONS INDICATORS (SEE NOTES)
		>12 mo.	1-12 mo.	1 da.-1 mo.	<1 da.[1]			
1. Electrostatic Precipitators (5 devices)	15.5	1	3	2	unknown	3610	157	3,5,6,7,4
2. Fabric Filters (5 devices)	16*	0	1	0	397	6	82	7
3. Carbon Bed Absorbers (2 devices)	7	1	0	2	2	170	117	5,7
4. Scrubbers (7 devices)	29.5	3	1	0	unknown	280	120	6,7
5. Afterburner (1 device)	1		-No Data-			-No Data-	-No Data-	

1. The number of minor excursions above allowable emissions rates (i.e., 1 hour or less) cannot be estimated in most cases. For fabric filters it is arbitrarily assumed that 2 bags fail per month, resulting in excursions of more than 1 hour, but less than 1 day.
2. All sources emit particulates except for the 2 surface coating operations which emit hydrocarbons.
3. Opacity records.
4. Malfunction reports.
5. Operating logs.
6. Stack tests.
7. Engineering judgment.

* Data for one source not included because of lack of emissions data despite 25 years service.

Source: PEDCo Environmental

- Improper control equipment installation practices
- Lack of instrumentation
- Lack of spare parts
- Routine (not preventable) component failure
- Improper operation of equipment
- Improper equipment maintenance.

According to the exhibit, poor design efficiency was the single largest primary cause of excess emissions, and improper materials of construction was the single most frequent contributing cause. Again, it is necessary to remember that the small sample size and questionable quality of some of the data precludes the generalization of these findings to all major sources in North Carolina.

III. EFFECTIVENESS OF AGENCY PROGRAMS

Based on an analysis of the data collected from the review of agency programs and 20 case studies of source performance, Booz, Allen and PEDCo have concluded that although the State of North Carolina has sufficient program mechanisms with which to promote continuing compliance, it does not use them in the most effective manner. This chapter of the Task III report describes in detail the principal strengths and weaknesses of the North Carolina program and documents each finding with data from the study's earlier tasks. Where weaknesses are identified, either in specific program elements or underlying management and administrative practices, the chapter describes the possible contributory factors and recommends specific corrective actions North Carolina can take within the framework of the current direct regulation approach.

1. THE PERMIT PROGRAM

Although the permit program as organized prior to September 1, 1978 provided the Air Quality Section (AQS) of the Division of Environmental Management (DEM) with an opportunity to encourage sources to comply with emission standards and related regulatory requirements, technical and procedural weaknesses in program implementation have undermined its effectiveness. The principal strength of the program appears to be its application to both existing and new sources. Specific weaknesses detected are:

- Inadequate technical reviews of applications
- Insufficient concern with O&M measures
- Lack of coordination between air and water quality permitting.

A detailed discussion of these findings follows. For each of the weaknesses identified, the discussion attempts to identify possible contributory factors and to recommend corrective actions.

the 20 sources investigated in North Carolina. Specifically, deficiencies in design resulted in the noncompliance of 7 out of the 9 sources with compliance problems. The following incidence of deficiencies was found:

- Use of improper materials in constructing controls (4 sources)
- Undersizing of controls (3 sources)
- Little or no instrumentation on the control equipment (5 sources)
- Inaccessibility of control components for proper operation and maintenance (several sources).

As a result, these sources encountered unanticipated equipment failure and extended periods of excess emissions, as well as unplanned and costly redesign, repair, and replacement of control equipment. The numerous design flaws cast doubt on the effectiveness of the agency's permit review procedures.

1. Underlying Causes

The major reasons for the permit review problems cited above appear to be the inadequacy of technical guidance available to permit reviewers, the inexperience of permit reviewers, and the emphasis on fostering initial rather than continuing compliance. Interview data suggests that the permit reviewers have relied on technical guidance which is both outdated and incomplete. For example, one of the EPA publications[1] on which permit reviewers rely is based on information first compiled in 1963 by the Los Angeles air pollution control agency, covering only those industrial categories which pertained to the Los Angeles area. Even the most recent edition of this document contains many outdated references. The second publication[2] which the

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1 Air Pollution Engineering Manual, U.S. Environmental Protection Agency, Research Triangle Park, North Carolina. Publication No. AP-40, Second Edition, 1973.

2 Compilation of Air Pollutant Emission Factors, Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency, Research Triangle Park, North Carolina. Publication No. AP-42, Third Edition, August 1977.

expect that a control plan approved by the state, if properly carried out, will result in compliance. Therefore, where the source experiences unanticipated problems which might have been averted by a better permit review, it is likely that the previously good agency/source rapport may be undermined.

(3) Agency Failure To Include O&M Related Requirements in Permits Undermines Source Ability To Maintain Compliance

Although North Carolina statute and regulations provide ample authority, the DEM does not as a general practice use the permit to require in-stack or ambient monitoring, recordkeeping, or certain operation and maintenance procedures. The absence of these requirements often results in both the source and agency having insufficient information with which to make a reliable judgment of the source's compliance status or to develop O&M procedures likely to correct detected violations. Of the 20 sources examined, 60 percent failed to keep any operating records at all that would enable an independent assessment of past compliance. Of the 9 sources with significant compliance problems, our assessment is that for 5 of them better recordkeeping and operation and maintenance procedures would have reduced excess emissions.

1. Underlying Causes

The agency's apparent failure to use the permit as a mechanism for encouraging good O&M practices reflects the following factors. First, the state legislature already has required the agency to rescind source self-monitoring requirements the agency imposed despite the lack of Federal requirements. Second, the state, as evidenced by the legislature's action, apparently is reluctant to impose costly requirements on industry. Third, until recently, agency activity clearly has focused on initial rather than continuing compliance. Evidence for this is that between fiscal 1975 and 1979, the agency initiated close to 200 special orders by consent (SOC's) in order to get sources to adopt controls to meet emission standards.

for the most part, incidents of excess emissions identified in Task II were not attributable to the unavailability of spare parts. The principal impact of the requirement, therefore, would be to encourage sources in general to pay closer attention to equipment operation and maintenance, as in the case of source #14.[1]

(4) Uncoordinated Water and Air Permits Review Has Contributed to Episodes of Noncompliance

Our investigation of 20 sources revealed at least two cases where the lack of coordination between air and water quality permit reviews either delayed a source's initial compliance or contributed to a failure of control equipment. In the first case, the agency issued a temporary permit which allowed the discharge of air contaminants for seven months at which time the source was supposed to have proper controls. The source failed to comply, however, not even beginning construction of the control system until two years after the issuance of the initial temporary permit. Eventually, the agency and source entered into an SOC which established construction milestones and specified a date for achieving final compliance. However, according to our investigation, at that point the source missed its scheduled date for bringing the equipment on-line because the Water Quality Section had been tardy in issuing the required water quality permit. In the second case, water quality permit reviewers have imposed requirements which pose O&M problems for air pollution control equipment. For example, a requirement for recirculation of scrubber liquor increases the acidity concentration and accelerates the corrosion of the scrubber. As a result, sources have found themselves involved in costly repair and replacement efforts.

1. Underlying Causes

The absence of a coordinated review of air and water quality permit applications results from the

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1 Source #14 is a 25-year old baghouse serving stone products handling (fugitive dust). The source has been out of compliance with opacity requirements almost continuously. As of October 1978, it was in compliance, largely as a result of agency efforts to encourage better O&M. However, the principal cause for noncompliance is the age of the control equipment and the lack of incentive to recover the particulate matter.

has 60 days following the notice and within 90 days following a public hearing to issue or deny a permit. Thus the time frame for issuance of a water quality permit potentially is significantly greater than that for an air quality permit. In addition, the agency apparently has no internal guidelines for coordinating the two processes and provides applicants with no guidance for facilitating such coordination.

2. Recommended Corrective Action

In order to correct the present incompatibility between the two permitting programs, EMC should adopt a policy and DEM should draft guidelines for a simultaneous and coordinated technical review of proposed air and water quality control plans. Both the EMC and DEM have the authority to foster this coordination without seeking legislative action. A simultaneous review is likely to decrease the time lag between issuance of each permit. In addition, a simultaneous, coordinated review will foster consideration by both sets of reviewers of the cross media impacts of their requirements. The resulting reduction in conflicts will enhance the agency's image and provide sources with an incentive to remain in compliance.

2. THE SURVEILLANCE PROGRAM

The overall assessment of surveillance and monitoring activities is that DEM has available to it adequate mechanisms for detecting violations and fostering their correction but fails to maximize their effectiveness. Specifically, the findings outlines below document the wide variety of available surveillance techniques and agency's efforts to use them in concert with planning surveillance strategies. While agency efforts are partially successful, specifically with regard to implementing the permit renewal process and to detecting/correcting opacity violations, the agency is unsuccessful in two other respects. One, its failure to maximize use of its stack testing capabilty reduces the detection and thus correction of nonopacity violations. Two, the weaknesses characterizing site inspection activities undermine agency effectiveness in carrying out the EMC voluntary compliance policy.

(2) The Permit Renewal Process Has the Potential To Be a Particularly Effective Incentive for Sources To Achieve and Maintain Compliance

Unlike the permit program, the renewal program benefits from the extensive involvement of regional personnel. According to the Task I interview data, the key step in the renewal process is the regional inspector's review of the renewal appliaction. This review includes a site inspection to ascertain any changes in source operations and compliance status. Based on this inspection and his familiarity with the source, the inspector forwards a report containing findings and recommendations to headquarters. Typically, according to Task I investigation, the headquarters review of the report affirms the recommendations of the region.

A second, positive feature of the program is that it provides the state with an additional, periodic opportunity to ascertain a source's compliance status. DEM currently tracks permit expiration dates by computer, each month identifying sources which have failed to comply with renewal requirements. As mentioned above, regional inspectors must conduct a site investigation in connection with the renewal. In addition, inspectors sometimes conduct stack tests at this time to ascertain compliance. An important objective of the site visit is to determine the accuracy of the source's statement in its renewal request that it has not substantially modified its process from the parameters cited in the initial application. Where the inspector detects significant changes, he recommends denial of the renewal request and submission of an entirely new application.

Data from both Tasks I and II illustrate the program's potential effectiveness. Task I interviews, for example, revealed circumstances in which the granting of a renewal with a stipulation to adopt controls within a specified time fostered a return to compliance. Similarly, the report Task II cites the case of a 25-year old baghouse where, in the absence of economic incentives, a threat to deny renewal was a major factor in the agency's success in fostering a return to compliance and at least a limited preventive maintenance program.

actual emissions problems. Specific inadequacies in the inspections included an overreliance on opacity as an indicator of particulate mass emissions, the failure of inspectors to review operations records, and the failure of inspectors to analyze solvent samples to determine compliance with HC regulations, and the failure to supplement inspections with stack tests.

1. Underlying Causes

Both technical and institutional factors contribute to the superficiality of site inspections. Technical problems appear to include the absence of inspection guidelines, low amount of interaction among regions, insufficient dissemination of technical information from headquarters to the region, and inadequate exercise of training opportunities. When respect to this last point, interview data for Task I suggested that EPA's presence in North Carolina provided ample training opportunities for both headquarters and regional staffs. However, discussions with regional inspectors during the conduct of Task II revealed that regional staffs are discouraged from attending the courses offered.

The institutional aspect of the problem, which is quite difficult to document, is that many regional inspectors indicated that they felt a disincentive to conduct thorough inspections. Specifically, inspectors cited instances when the Air Quality Chief or DEM Director would overrule a recommendation for a stack test. Regional inspectors also asserted that data on source inspections and violations they had sent to the central files had been "checked out" and never returned. As a result of the disappearance of significant data on source performance and the overruling of regional recommendations for additional or more aggressive surveillance of certain sources, several inspectors indicated that their principal objective is to meet EPA reporting requirements rather than to foster continuing compliance.

2. Recommended Corrective Actions

Possible solutions to the present superficiality of some inspections include:

Another characteristics of the enforcement program which is supportive of the voluntary compliance policy is the prominent role of regional inspectors. These inspectors are responsible for initiating all enforcement mechanisms: NOV's, SOC's, and civil penalties. The Enforcement Office has no authority to take any initiative in using these tools; rather it ascertains that air quality staff use SOC's and recommend penalties in accordance with legally acceptable standard of proof.

Given the difficulty agency inspectors face in detecting violations and the inadequacy of agency records on the day-to-day compliance status of sources, it is difficult to assess whether a more aggressive enforcement program, particularly with respect to the use of civil penalties, would be more effective in fostering continuing compliance. However, there appear to be at least some cases where the threat of a penalty might motivate sources to take corrective action.

(1) <u>The Special Order By Consent (SOC) Appears To Have Been an Effective Measure for Promoting Initial and Continuing Compliance</u>

The Special Order by Consent (SOC) is a key component of the agency's efforts to encourage voluntary compliance, that is, compliance in the absence of a civil or criminal penalty. Resulting from negotiations between the source and the agency regarding actions the source should take to comply with emission requirements, the SOC specifies the dates by which the source will complete the following steps:

- Submit control plans
- Award contracts
- Begin construction
- Achieve compliance.

As its name implies, the SOC is entered into voluntarily by the source. Although the agency has the legal authority to issue a special order unilaterally (without consent), it never has done so. The interviews with both agency and source personnel suggest that this reflects source willingness to adhere to the regulatory requirements.

The frequency with which the agency has used the SOC coupled with the relatively low number of SOC's leading to the issuance of civil penalties also suggests

and begin to build a record for a civil penalty proceeding frequently have been denied. Finally, interviews with both headquarters and regional personnel suggest that at times the Director of the DEM has issued penalties significantly below the amount which the regional office recommended.

Given the inadequacy of agency recordkeeping practices as discussed below in Chapter III, it is difficult either to document the underlying causes for this situation or to recommend program modifications. Apparently, the relative effectiveness of the air quality program depends upon the maintenance of a delicate agency/industry balance. Thus significant political pressures may exist to minimize enforcement activities even when the voluntary compliance approach fails to yield rapid results. One such pressure may be the statewide emphasis in recent years on the fostering of economic development.

4. AGENCY MANAGEMENT AND ADMINISTRATIVE PRACTICES

An agency's available resources and operational procedures affect its ability to evaluate its own effectiveness and define and adopt needed modifications. Accordingly, Booz, Allen's evaluation of the effectiveness of North Carolina's air pollution program included an assessment of:

- Manpower and budget resources
- Budget practices
- Recordkeeping practices.

We found that between 1967 and September, 1978 the agency did not adjust its management and administrative practices to its substantial increase in size. The informality which worked well for a staff of twelve was inappropriate for a staff of over seventy.

(1) Manpower and Budget Resources Rose Rapidly To Meet the Demands of the Clean Air Act of 1970

Although the North Carolina legislature established a state level agency in 1967 to develop and implement an air pollution control program, the present programs, budget, and manpower levels essentially reflected the regulatory requirements imposed upon the state by the Federal Clean Air Act of 1970. As a result of this Act, North Carolina had to revise its emission inventory and

experienced staff members whose replacements will have to rebuild the previously long-standing relationships with source personnel.

1. Underlying Causes

There appear to be two factors affecting the turnover rate. The first factor is that modest peaks in FY 1973 and FY 1978 coincided with agency reorganizations. It is not unusual for dissatisfaction to run higher during such periods when staff members face uncertainties regarding their present responsibilities and administrative reporting relationships, their long-term professional opportunities, and other aspects of their work environment. For example, interviews with DEM personnel hint at significant staff and management level disagreement over the recent reorganization from an environmental media to functional structure.

The second factor cited by agency staff is the increasing competition for competent professionals from private industry and research/consulting organizations. Although salaries in each state pay grade have risen every year except one since 1970 and although several air quality job categories were upgraded in 1973/74, apparently present salary levels are not sufficiently competitive with private sector salaries. Evidence of this trend is the fact that most of the staff members resigning during 1978 took private sector positions.

2. Recommended Corrective Action

Neither of the two underlying causes of the periodic peaks in turnover are amenable to simple solutions. Dissatisfaction and uncertainty always is likely to accompany a reorganization, and the DEM offers of employment are constrained by statewide salary schedules and civil service practices. However, given the importance of maintaining as much staff continuity as possible, the DEM management should take steps to provide its personnel with a work environment which is as professionally rewarding as possible. For example, it should

programs, and define and adopt program changes. Specific problems are as follows. First, the agency does not maintain a record of the total number of emission points in the state and therefore is unable to determine how many noncomplying emission points exist in the state. Since many sources have multiple emission points, the fact that only 35 major sources are classified as being in noncompliance does not provide a complete, statewide picture of excess emissions. Second, the agency does not maintain a central, comprehensive record of whether sources on SOC's have met their scheduled compliance dates. Although regional inspectors track these dates carefully, the absence of a central record in headquarters constrains the capability of top management to evaluate the effectiveness of the SOC mechanism and consider adjustments in its use. Similarly, top management has no accessible record on whether the issuance of a civil penalty resulted in a correction of the violation. Therefore, it is difficult to ascertain whether the civil penalty authority is used sufficiently and whether more frequent use or higher penalties would improve continuing compliance. A third example of the problem is that even for a specific source, agency personnel experience difficulty in obtaining a definitive performance profile. Our inspection of source files in both headquarters and the regions showed them to be disorganized and incomplete. Specific problems included missing permits, gaps in inspection data, data out of chronological order. Thus top management would find it difficult to monitor and evaluate the strategies used by regional staffs to foster source compliance.

The interviews with agency personnel provided no substantive clues to the reasons for the inadequacy of recordkeeping practices. The most apparent explanation is that the agency has not strengthened and formalized its recordkeeping practices to support its increased size and responsibilities.

The agency appears to have a sufficient amount of raw data with which to make decisions, perhaps with the exception of not knowing the total number of emission points. Therefore, the preponderance of corrective action would involve the compilation and analysis of the raw data so that the agency would have both an historical and continually updated profile of source compliance and thus program element effectiveness. In addition, it needs to systematize its record retrieval and maintenance procedures to ensure the ongoing integrity and completeness of the files.

IV. ECONOMIC INCENTIVES

In order to improve its effectiveness in promoting stationary source emissions reductions, the State of North Carolina could either strengthen its existing direct regulation programs or adopt supplements and alternatives to regulation.

Since Chapter III already has addressed adjustments to the current programs, this chapter merely summarizes those recommended adjustments in Exhibit IV-1 and focuses on potential supplements and alternatives.

Our presentation of alternatives to current programs consists of the following. First, we briefly summarize major factors which need to be considered in designing and evaluating economic incentive programs. Second, we describe four possible economic incentive program categories and assess their potential applicability to North Carolina's situation.

1. EVALUATION FACTORS

The actual adoption of economic incentives must reflect an assessment of their likely effectiveness in promoting a reduction in excess emissions and an identification of the statutory and institutional changes needed. Key factors to be considered in this assessment include compatibility of economic incentive programs with the technical and administrative requirements for existing programs; the level of control technology available and impact on technology forcing; monitoring, and enforcement requirements. These factors are reflected in our estimate of the likelihood of economic incentives contributing to a further reduction of excess emissions in North Carolina.

2. ECONOMIC INCENTIVE PROGRAMS

The following discussion of four categories of economic incentives distinguishes between programs most helpful in fostering initial compliance and those promoting continuing compliance. It also assesses the extent to which each incentive would be appropriate to North Carolina's situation.

(1) Reducing Financial Burden

The alternatives in this category primarily are useful in promoting initial compliance as they relieve the financial burden of installing costly pollution control equipment. They include:

- Tax credits for industries achieving compliance
- Federal/state/local cost-sharing funds for abatement equipment
- Low interest loans for industries purchasing and installing abatement equipment.

North Carolina presently has two programs to provide tax incentives to complying facilities and to assist sources in financing the pollution control equipment. First, under North Carolina General Statutes Chapter 105-130.10 "Amortization of Air Cleaning Devices and Waste Treatment Facilities" facilities can take a tax deduction for the purchase, construction, and installation of air pollution control devices. To be eligible for the deduction, sources must obtain a certificate from the Secretary of the Department of Natural Resources and Community Development (DNRCD) stating that the source has installed control devices in compliance with air pollution abatement regulations and that the devices are effectively operated in accordance with permit stipulations.

Second, in an effort to balance pollution control and economic development, the legislature in Chapter 159(c) of the General Statutes authorizes counties to establish a County Industrial Facilities and Pollution Control Financing Authority. Three principal steps are involved in the establishment of the authority. First, the county most notify both the DNRCD and the local government commission of its intention to create the authority. Second, the county must create the authority by resolution; and third, the county must create a seven member board of commissioners to direct the authority. The statute requires that DNRCD approve projects prior to the issuance of bonds and establishes the following conditions for project approval:

- The project will have a favorable environmental impact or prevent/diminish the impact of pollution which would otherwise occur.

Currently, private sector sources receive no direct financial assistance from government. Even if the capital and O&M costs are not burdensome and are not a significant contributing factor to noncompliance, industry is likely to welcome a revenue sharing plan. However, in the absence of any clear evidence that industry requires financing assistance, such a measure is likely to be politically infeasible and is unlikely to result in emissions reductions.

(2) Providing Investment Incentives

Several pricing mechanisms are available to give incentives to polluters to install control equipment (initial compliance) and operate and maintain it (continuing compliance) properly. Major alternatives in this category are:

- Taxes on polluting industries
- Surcharges on pollution-intensive goods
- Emission charges
- Noncompliance fees
- Delayed compliance fees.

Under the first mechanism, the tax could be imposed either on production materials or on the finished product. In the former case, the tax rate could be varied according to the difficulty of eliminating pollutants discharged and in the latter case could be a fixed tax on each output. The objective is to make it economical for the source to use less-polluting process materials or to adopt end-of-the-pipe controls.

The second mechanism essentially places the cost burden on the consumer, putting a tax on products which have adverse environmental impacts. Presumably, the producer would be motivated to make his products less environmentally harmful to avoid the adverse impacts on product competitiveness resulting from the surcharge.

Emission charges, the third alternative, consist of making the polluter pay a sum proportional to the amount of pollution discharged. While, in theory, the charge should be linked to the damage function, that is the exact amount of environmental damage caused, in practice such charges would have to be

existing weaknesses such as the insufficiency of stack testing and inadequacy of current recordkeeping practices.

(3) Instituting Hybrid Permit Systems

This category of alternatives is based on the idea that emission standards specify the "pollution rights" available to each source. Three possible mechanisms are:

- Marketable discharge permits
- Differential pricing of permits
- Sureties.

Each of these contributes differently to the fostering of initial and continuing compliance.

Marketable discharge permits are permits which would be negotiable and sold at prices determined by the demand for emissions rights. Under the system, sources reluctant to shoulder the capital and O&M costs of installing equipment could purchase pollution rights from sources willing to invest in a level of control beyond the requirements. The public sector, that is the regulatory agency, could abate pollution by purchasing permits, thus reducing the total amount of allowable emissions. This mechanism would promote both initial and continuing compliance.

Differential pricing of permits also can be used to promote both initial and continuing compliance. Regulatory agencies would continue to issue permits but would charge a fee based on the level of controlled emissions. Sources which exceed the emissions for which they paid would face an additional charge. Presumably, if these fees are set sufficiently high, sources would find it economical not only to install control devices but also to operate and maintain them properly.

A surety system, the third alternative under this category, would operate in much the same manner as a performance bond. The source would place a set sum in escrow. The source would forfeit a portion of the sum for a certain level, frequency, or duration of excess emissions whereas it would receive a rebate varying according to the degree emissions were reduced below the standards. By requiring sources to post a

increase requests. While the advertising fund could be established by imposing or increasing a tax such as one on the use of recreation facilities, state legislatures tend to be reluctant to impose additional costs on their constituents, particularly if the benefits are not clearly documented.

The final disadvantage of these strategies is that they fail to address the weaknesses of the current programs in North Carolina. Like those programs, programs in this fourth category of nonregulatory approach still require setting source specific requirements and monitoring and inspecting sources to determine their compliance with those requirements. Correction of existing program thus would have to precede adoption of either of the two strategies in this category.

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In order to document convincingly the appropriateness of nonregulatory alternatives in North Carolina, additional investigation is necessary. This investigation first should identify any improvements in program operation and administrative procedure resulting from the September 1978 reorganization. Second, it should poll various interested parties to determine more thoroughly the institutional and politcal feasibility of various incentives. Finally, it should define a strategy for adopting those incentives which are likely to promote continuing compliance.

APPENDIX A
Source Costs of Emissions Reductions

Source	Industry Category	ACFM	Potential Emissions Tons/yr	Reduction Tons/yr	Capital Costs 1978 $[1] (x1000)	$/acfm	Capital Costs $/T/yr/potential	Annual O&M Cost 1978 $[1] (x1000)	Annual O&M $/T/yr reduced
1	1	4.0×10^6	2.50×10^6	2.42×10^6	6,450	1.60	2.56	250	0.10
2	12	9.0×10^3	6.00×10^2	5.47×10^2	29.7	3.30	49.00	*	*
3	14	3.6×10^4	1.67×10^3	1.65×10^3	*	*	*	*	*
4	15	3.4×10^4	6.50×10^2	*	485	14.43	*	*	*
5	1	5.5×10^5	2.84×10^4	2.81×10^4	5,670	10.34	200.00	*	*
6	2	5.4×10^5	2.08×10^5	2.08×10^5	25,700	47.60	123.60	*	*
7	8	4.0×10^4	1.20×10^2	8.80×10^1	441	11.00	3,675.00	*	*
8	2	5.2×10^5	3.90×10^4	3.85×10^4	12,700	24.20	325.64	*	*
9	12	2.0×10^4	4.90×10^3	4.56×10^3	5.2	0.26	1.07	*	*
10	16	3.0×10^4	1.40×10^3	1.25×10^3	700	23.30	500.00	*	*
11	6	3.0×10^4	6.30×10^3	5.90×10^3	98	3.28	15.56	*	*
12	16	1.0×10^4	2.00×10^3	1.61×10^3	2,000	20.00	1,000.00	*	*
13	16	1.1×10^4	2.10×10^2	1.36×10^2	90	8.18	428.57	25	183.80
14	12	2.4×10^4	*	*	*	*	*	*	*
15	1	2.5×10^4	8.25×10^2	5.81×10^2	88	3.52	106.67	120	20.65
16	2	3.3×10^4	2.90×10^4	2.90×10^4	580	17.58	20.00	129	4.45
17	16	8.0×10^3	*	*	340	42.50	*	*	*
18	12	1.5×10^4	3.70×10^2	3.45×10^2	*	*	*	*	*
19	11	9.5×10^3	6.50×10^2	*	*	*	*	6.2	*
20	14	6.0×10^3	1.00×10^2	8.70×10^1	*	*	*	*	*

*No data.

Source: PEDCo Environmental

APPENDIX B
Agency Costs of Regulating Sources (Planned)

PROGRAM ACTIVITY	FY 1977 BUDGETED AMOUNT	FY 1977 PLANNED OUTPUTS	FY 1977 COST PER OUTPUT	FY 1978 BUDGETED AMOUNT	FY 1978 PLANNED OUTPUTS	FY 1978 COST PER OUTPUT	FY 1979 BUDGETED AMOUNT	FY 1979 PLANNED OUTPUTS	FY 1979 COST PER OUTPUT
Permits Issued	55,549	500	- 111.10	123,865	831	147.99	172,316	726	237.35
NSPS Issued	N/A	N/A	N/A	780	9	86.67	7,333	12	611.08
PSD Issued	N/A	N/A	N/A	780	3	260.00	35,746	6	5,957.67
Region Review of Permits	23,970	599	-40.02	24,188	593	40.79	164,525	714	230.43
New Source Impact Analysis	33,482	48	697.54	47,791	46	1,038.94	52,473	36	1,457.58
SIP Inspections	309,517	8,283	37.37	162,488	3,238	50.18	154,213	1,629	94.67
Engineering Evaluations	N/A	N/A	N/A	104,944	2,247	46.70	168,420	3,063	54.99
Compliance with SOCs	31,389	869	36.12	99,873	643	155.32	24,285	224	108.43
Permit Follow-ups	71,339	2,192	32.55	113,917	2,747	41.47	109,780	1,081	101.54
Compliance with NSPS, NESHAPS, PSD	N/A	N/A	N/A	1,170	15	78.00	6,416	27	237.63
Fuel Sampling	4,375	261	16.76	7,217	229	31.51	3,666	199	18.42
Visible Emissions Evaluations	N/A	N/A	N/A	21,847	108	202.29	30,247	124	243.93
Source Tests Conducted	54,789	60	913.15	79,781	82	972.94	101,510	83	1,223.01
Source Tests Observed	72,861	42	1,734.78	15,800	33	478.79	13,978	25	559.12
Violations of SOCs or Permit Schedules	N/A	N/A	N/A	585	12	48.75	4,812	23	209.22
Violations of Emission Stds	4,566	N/A	N/A	3,901	8	487.62	7,562	15	504.13
Open Burning Violations	8,561	100	85.61	5,072	31	153.70	2,521	9	280.11
Actions Against NESHAPS Violators	N/A	N/A	N/A	N/A	N/A	N/A	2,291	1	2,291.00
Actions Initiated Against Major Sources	N/A	N/A	N/A	N/A	N/A	N/A	41,017	31	1,323.13
			1,705			4,321.66			15,743.44

Source: Booz, Allen & Hamilton developed estimates of program element budgets by apportioning total air quality budget among the elements. Total air quality budget and planned output figures came from the Department of Natural Resources and Community Development, Division of Environmental Management. Program Plan (FY 77, 78, 79).